

**IDENTIFICATION, COMPARISON AND CLASSIFICATION OF NEW PRODUCTS DEVELOPMENT
EFFECTIVE FACTORS IN IRANIAN AUTOMOTIVE INDUSTRY
(CASE STUDY: SAIPA AND PARS KHODRO COMPANIES)**

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ABSTRACT

The organizations attempt for finding factors creating competitive advantage in today economic world. New product development process is considered a competitive advantage for various manufacturing / service organizations. New product development helps organizations to preserve their competitive and exclusive position in the competition market. Market dynamics, rapid technologic change and increased competition among active companies in the industry have changed sectors of the market and new product development has turn to as one of the most powerful tools to achieve success in business activities. Identifying changes in consumer needs and demands in different markets along with continuation of competition in business and developed economic boom led to implementation of new product development programs in the organizations. Aim of new product development may be fulfilling customer needs, adapting to the market conditions and environmental changes, increased profit, customer satisfaction and cope with competitor policies. Current work attempts to introduce new product development and its strategies, patterns, and process and discuss goals and importance of new product development. Key factors of product development are classified into four main classes: process factors, strategic factors, technologic factors, and organizational factors. It is attempted to identify and measure these factors in new product development in SAIPA and Pars Khodro companies and compare them. They are ranked using Analytical Hierarchy process (AHP).

KEYWORDS: Analytical Hierarchy process (AHP), Innovation, New Product Development (NPD), Technology.

INTRODUCTION

Change in customer needs and demands, rapid technologic change and increased competition in the market and improved economic boom led to the fact that companies in different industries deal with innovation and new product development in a growing speed, productivity and quality. In fact, costumers seek for newer, more advanced, and adopted products and companies are forced to produce products which fulfill customer needs and expectations, since otherwise competitors would surpass. It has increased importance of product development in the companies and industries and new product development has turn to as one of the most complicated and difficult tasks of business (Nouralizadeh, 2012).

Customer needs and demands are the main motivating factor for providing new product or service in the organizations. New product development process is considered as competitive advantage for different manufacturing / service organizations. The extent of R&D and new product development activities in the organizational activities is the fact that is associated to the current and strategic status of the organization in the demand market. Customer need is always the factor which encourages innovation and creativity in the organizations for their business processes and will force them to invest more on their development process in order to retain existing customers and encourage potential ones (Amiri, 2007). Competition in the current era convers all branches of product manufacturing from design to market entry stages. Such competition is based on demands for tens of thousands of business activities including a wide range of activities such as market research, product development, and production and service

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process. Application of new product development process is necessary in such complex and competitive environment in order to respond companies' needs successfully in global business area. In today's economic world, most companies seek for finding factors creating competitive advantage. Undoubtedly, new product development is an introduction to enter this stage. Most leading companies in the world are totally aware of the fact that the main factor for their excellence in the global competitive market is having sustainability in new product design and delivery to the market in a rapid and more effective way than competitors. New product development and existing product improvement play a critical role for survival of the successful manufacturers. Certainly idea standards in this area are manifested for new product development. New product development is a very important process to guarantee the company survival for fulfilling national welfare and economic development. New product quality, customer accountability, process control and agility development are now the major components which have become indexes for competence of the global product. In the world where achievement of zero loss and high reliability are on the top priority, product production should move to science stage from skill stage. Thus, it requires accurate attention for creating an environment suitable for R&D, innovation, successful process design, new product production, marketing, and development (Akhbari, 2007).

REVIEW OF LITERATURE

General, new product development is recognized as a process for devising new product which is distinctive of current and previous products. Hence, NPD is considered as one type of product innovation. Product Development and Management Association (PDMA) defines new product development as follows: a collection of regular and defined tasks, stages, and measures which describe intention of the company for turning initial ideas to consumer goods and services. According to Clark and Fujimo, new product development process is the integrated system of information transfer and creation which is implemented in a system of interrelated chains. Driger introduces new product development as a collection of activities which transfers customer instructions and orders, market demand, and technology progress within design and production process (Ardakani, 2012). New produced product can be classified based on innovation level. Table 1 gives a summary of this classification (Pitt, 2008):

Table 1. Classification of new product based on difference in innovation level

New for all markets (globally)	New product which creates new market
New for the organization	The product which allows organization to enter an existing market for the first time
Adding to existing products in the production line	New product which complements the company's existing products.
Enhancing the company's existing product	New product which has better performance and creates more value with the existing product improvement, and replaces the company's current product
Changing position (Repositioning)	New target market is defined for the current product
Cost Reduction	The product which a similar performance at a lower cost compared with current product

Innovation is not a new concept and as mentioned new product development is considered as one type of innovation. There are several definitions for innovation:

- Innovation means introducing a new thing or new idea, method, or equipment (Merriam-Webster Dictionary, 2004).
- Innovation is an activity that its resulting idea or product enters the market, persists in the market, and creates social and economic impact (Soltani Tirani, 1999).
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- Innovation is a process through which new or modified products, processes, materials, and services are developed and transferred to a suitable market (White and Bruton, 2007).

Technology, which plays important role in new product delivery process, is in the form of all knowledge, products, tools, methods, and systems which are used so that a product or service is provided. Technology is the methodology and tool through which the goals are achieved (Khalil, 2000). It is regarded as strategy and goal which directs human

being toward skilled and effective production (Brown, 2003). Considering change in taste of consumers as well as changes in the competition and technologic conditions, a company is not able and should not merely rely on its existing products. The customers want new products and more advanced goods and it is the same thing which competitors seek for. New products are a necessity for the today companies. New products are actually response to the greatest problems of the organizations. New product development is significant part of every business and provides growth and competitive advantage opportunities for the companies.

Variability of competitive regulations in the business world increases importance of providing new products to the market. Most organizations have found that merely relying on traditional competitive levers such as increased quality, reduced cost, and distinction in products and services does not suffice, and such concepts as speed and flexibility have become especially important in the competition. Tendency to offering new products and services to the market is the justification for such attitude change. According to a survey in 1981 on 700 American companies, almost one third of profits of these companies was obtained through new products, while it was one fifth in the survey conducted in 1970 (Akhbari, 2007). Special attention to retaining competitive – commercial situation in the competition environment and attention to customer needs and tastes in the demand market are main and key factors in new product development. Speeding up the product development processes and rapider delivery of the products and services in the market is the issue which is specially considered by the companies and organizations. If product development process is considered as a match including three stages as follows:

- Production Stage: initial idea development for new product until the stage before product delivery in the market
- Market Entry Stage: stage of product delivery and supply in the market (market measurement for product)
- Profit Gaining Stage: stage of transition from breakeven and profit gain,

Then the company will win the match which wins all three stages. Obtaining such success would lead to call product development process as a success attainment process. Starting point for the companies, which want to be innovative and to be active in new product development area, is creating a new product development process and defining and classifying processes required by new product development (Akhbari, 2007).

Given process classification framework provided by America Productivity and Quality Center (APQC), the process needed by the new product development project's team and organization within product development lifecycle are classified as follows (APQC, 2005):

- Strategic level processes
- New product technical level processes
- Sales and new product sale support level processes
- Management and project support level processes
- Supply management level processes
- Infrastructure, capabilities and knowledge management level processes.

Robert Cooper outlined the key success factors for new product development as follows: (Robert G. Cooper, 2003):

- Proper orientation on the market, paying attention to market-oriented and customer-oriented product
- Focus on providing a world-class product and having an international orientation in the design, development and marketing processes
- Paying attention to the pre-development activities, i.e. practicing product development process and preparing for the development prior to the start of the main product development project
- Quick project and product definition, this quick definition is considered as criteria for success or failure
- Timely provision and launch of the product in the market
- Paying attention to suitable organizational structure, design and organizational atmosphere
- Continued support of senior management, not only as a guarantee of success in the development process, but also as an aid for new product development project

Decision making is one of the most basic tasks of management and realization of organizational goals depends on its quality, so that according to Herbert Simon decision making is the essence of management. AHP, developed by an Iraqi man named Saaty in 1970s, is one of the commonly used multi-criteria decision making methods for solving

unstructured problems in various fields such as management, politics, economics, social sciences, medicine, engineering, genetics, geography, etc. (Momeni, 2011).

MATERIALS AND METHODS

Considering explanations in the previous sections, conceptual model in Fig 1 was applied to select key success factors. Key success factors are classified into four groups in this model:

1. Process factors
2. Strategic factors
3. Commercialization factors
4. Organizational factors

Following selection of key success factors in new product development, indexes related to each factor are specified and are given to the experts in both companies in the form of questionnaire. Process aspect includes 11 main indexes, organizational aspect includes 9 main indexes, strategic aspect includes 7 main indexes, and business aspect includes 6 main indexes, and the results were analyzed. Following summarizing indexes of the aspects, status of new product development management and the gap to optimal level was specified. It is a descriptive survey. Validity of the questionnaire was confirmed by expert ideas, and its reliability was supported by Cronbach's alpha coefficient 0.90.

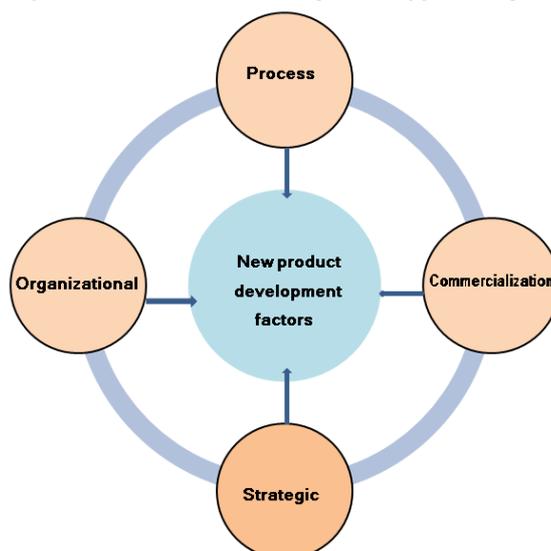


Fig 1. Conceptual model for new product development (Asari *et al.*, 2014)

In order to help managers for decision making, key factors in new product development are weighted and ranked using AHP and Expert Choice software. The relative importance (weight) of the indexes was determined and the options were ranked.

RESEARCH OBJECTIVES AND QUESTION

A. Main Research Questions:

1. How is status of the constituent indexes of new product development management in two companies?
2. How is status of the aspects of new product development management in two companies?
3. How is ranking of the aspects of new product development management in two companies?

B. Minor Research Questions:

1. How is status of the indexes in process aspect of new product development management in two companies?
2. How is status of the indexes in organizational aspect of new product development management in two companies?
3. How is status of the indexes in strategic aspect of new product development management in two companies?
4. How is status of the indexes in commercialization aspect of new product development management in two companies?

Statistical Population

Experts with MA degree and higher with 3 years of working experience (Diagram 1) included research statistical population. Research statistical population was specified considering condition of the company at the time of research.

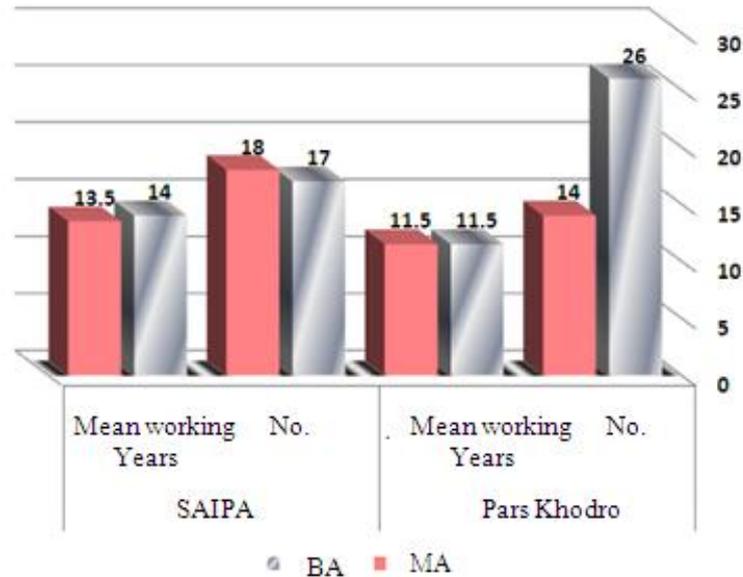


Diagram 1: Descriptive parameters of respondents on SAIPA and Pars Khodro companies

RESULTS AND DISCUSSION

Main Questions

Q1: considering data collected from questionnaire, status of the new product development in both companies in each indexes is specified in Table 2.

Q2: comparison of existing success level in new product development for the components as well as the gap to the optimal level is given in Table 3 and Diagram 2.

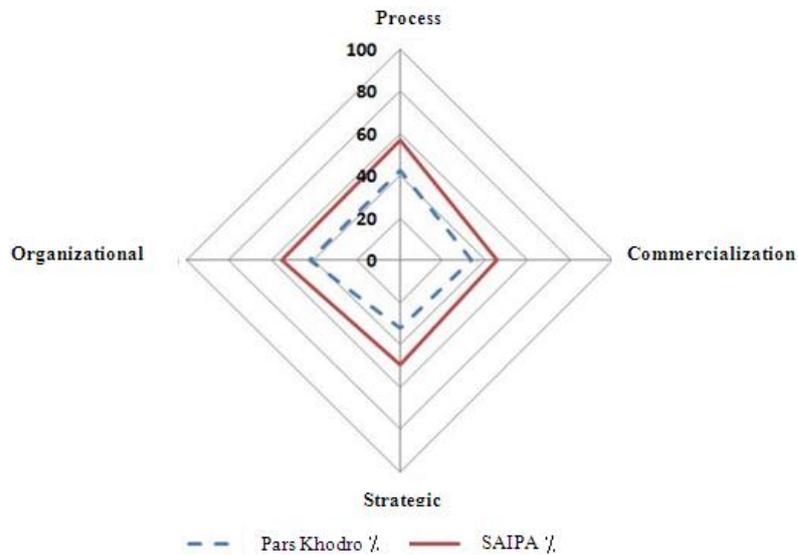


Diagram 2: Comparison of current status in aspects of both companies

Table 2. Status of indexes affecting new product development

Question / Index	Pars Khodro (%)	SAIPA (%)
The company has documented and transparent NPD process.	40.75	59.14
The lessons learned from previous experiences (previous experience in NPD) are used in new product development.	40.75	60.00
There is clear and shared vision among NPD project team members.	37.25	54.57
The company has accurate and correct product definition and configuration to develop new products.	30.5	57.14
There is accurate description for product performance and subsets and task definition and formulation and evaluation in new product development.	38	54.86
Accurate identification of stakeholder needs is done for new product development.	36.25	48.29
In new product development, product validation and verification is done after engineering sample.	59.25	65.14
Systemic planning and review of plan is done in development of new products.	41.75	63.43
Identification and investigation of product technologies are carried out systematically to develop new products.	46.75	49.43
Question / Index	Pars Khodro (%)	SAIPA (%)
Information technology and new methods of design (rapid simulation and computer modeling) is used in developing new products.	45.25	62.00
Definition and assessment of contributions required by suppliers in the NPD process takes place.	48.75	53.43
Support and commitment of senior management to develop new products is evident.	61.25	62.29
Management commitment and support in R&D to develop new products is evident.	45.5	55.71
There is environment and culture for encouraging NPD entrepreneurs in company.	33.5	47.43
Interdisciplinary and cross functional teams are used to develop new products.	34	51.43
Appropriate quality control system (quality of design) is utilized in the development of new products.	53	51.43
Suitable organizational structure is used in developing new products.	38.25	48.86
Sufficient funds are provided for managing NPD.	36.5	65.71
The company has access to knowledge-oriented and specialized human resources.	37.75	58.29
Level of technological capabilities and innovation of organization to develop new products is appropriate.	37	54.86
The company has the necessary risk taking spirit to develop new products.	40.75	54.57
Status of NPD in business strategy of the company is clear.	33.25	51.43
The company pays attention to the product life cycle in developing new products.	28.25	45.71
Question / Index	Pars Khodro (%)	SAIPA (%)
The company pays attention to planning and infrastructure investment level to develop new products.	36	52.57
Company formulates technology task strategies of R&D for new product development projects.	31.25	51.43
For new product development, an intelligent system in the company (including innovation management, knowledge management, technology management, strategic WAM) is established.	25	48.29
To develop new products, systematic observation of existing and emerging technologies takes place.	29.5	42.00
Shortening idea to market cycle is considered in new product development by concurrent engineering and timely NPD product delivery to market.	40.5	40.00
The company commercializes technologies resulting from new products separately.	25	42.00
After sale service design, systematic and timely logistic and support is considered for new product development.	40.75	50.57
The company pays attention to problems of the product after useful lifecycle of it in developing new products.	31	43.14
Product innovation and attraction in the view of market and customers is considered for development of new products.	34.5	51.14
Customer needs and expectations for new product development is systematically identified and considered.	31	45.43

Table 3. Comparing existing level to optimal level in components of new product development

Aspect	Pars Khodro (%)		SAIPA (%)	
	Existing Level	Existing Gap	Existing Level	Existing Gap
Process	42.3	57.7	57.04	42.96
Organizational	41.86	58.14	55.11	44.89
Strategic	32	68	49.43	50.57
Commercialization	33.79	66.21	45.38	54.62
	37.45	62.55	51.74	48.26

Q3: Relative weight of the indexes in both companies was obtained using pair-wise comparison and AHP, and new product development management aspects were ranked based on which. Diagrams 3 and 4 indicate the ranking.

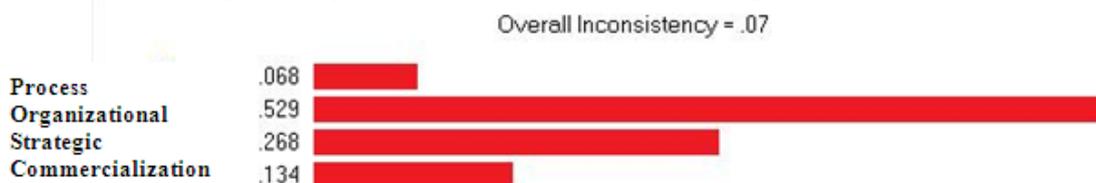


Diagram 3: Ranking new product development aspects in SAIPA Co.



Diagram 4: Ranking new product development aspects in Pars Khodro Co.

Minor Questions

Q1: Status of indexes in process aspect of new product development management is given in Table 4 and Diagram 5.

Table 4. Comparison of existing status in indexes in process aspect of new product development management

No.	Question/ Index	Pars Khodro (%)	SAIPA (%)
1	The company has documented and transparent NPD process.	40.75	59.14
2	The lessons learned from previous experiences (previous experience in NPD) are used in new product development.	40.75	60.00
No.	Question/ Index	Pars Khodro (%)	SAIPA (%)
3	There is clear and shared vision among NPD project team members.	37.25	54.57
4	The company has accurate and correct product definition and configuration to develop new products.	30.5	57.14
5	There is accurate description for product performance and subsets and task definition and formulation and evaluation in new product development.	38	54.86
6	Accurate identification of stakeholder needs is done for new product development.	36.25	48.29
7	In new product development, product validation and verification is done after engineering sample.	59.25	65.14
8	Systemic planning and review of plan is done in development of new products.	41.75	63.43
9	Identification and investigation of product technologies are carried out systematically to develop new products.	46.75	49.43
10	Information technology and new methods of design (rapid simulation and computer modeling) is used in developing new products.	45.25	62.00
11	Definition and assessment of contributions required by suppliers in the NPD process takes place.	48.75	53.43

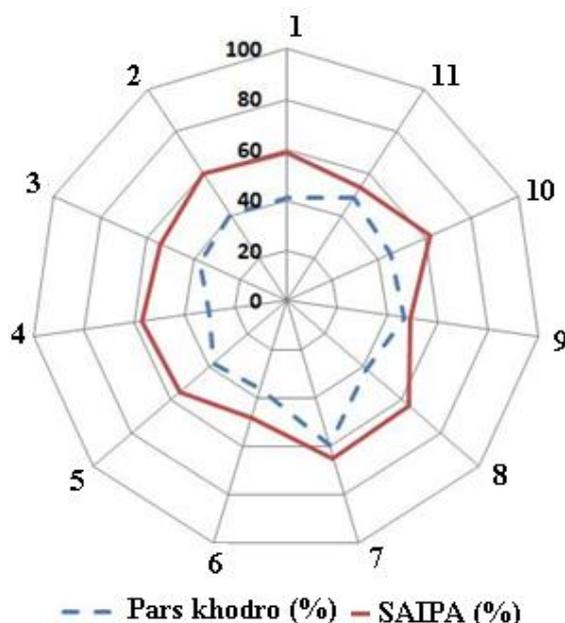


Diagram 5: Comparison of existing level in indexes of process aspect in both companies

Q2: Status of indexes in organizational aspect of new product development management in both companies is given in Table 5 and Diagram 6.

Table 5. Comparison of existing status in indexes in organizational aspect of product development management

No.	Question/ Index	Pars Khodro (%)	SAIPA (%)
1	Support and commitment of senior management to develop new products is evident.	61.25	62.29
2	Management commitment and support in R&D to develop new products is evident.	45.5	55.71
3	There is environment and culture for encouraging NPD entrepreneurs in company.	33.5	47.43
4	Interdisciplinary and cross functional teams are used to develop new products.	34	51.43
No.	Question/ Index	Pars Khodro (%)	SAIPA (%)
5	Appropriate quality control system (quality of design) is utilized in the development of new products.	53	51.43
6	Suitable organizational structure is used in developing new products.	38.25	48.86
7	Sufficient funds are provided for managing NPD.	36.5	65.71
8	The company has access to knowledge-oriented and specialized human resources.	37.75	58.29
9	Level of technological capabilities and innovation of organization to develop new products is appropriate.	37	54.86

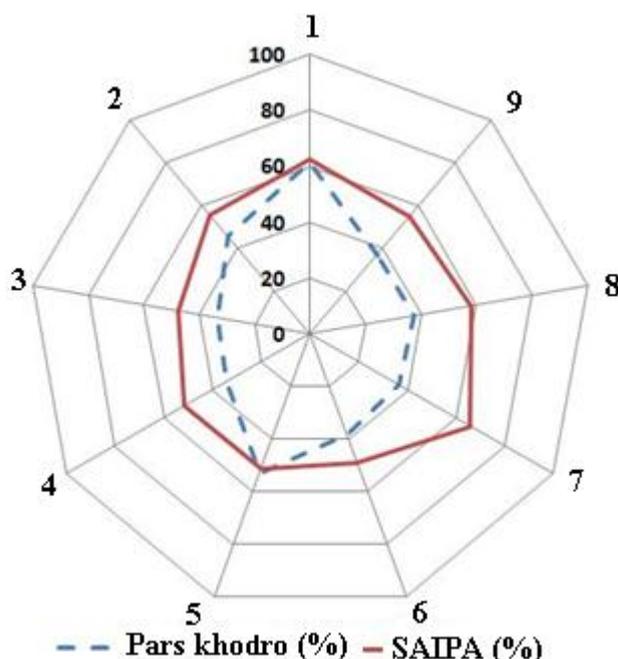


Diagram 6: Comparison of existing level in indexes of organizational aspect in both companies

Q3: Status of indexes in strategic aspect of new product development management in both companies is given in Table 6 and Diagram 7.

Table 6. Comparison of existing status in indexes in strategic aspect of product development management

No.	Question/ Index	Pars Khodro (%)	SAIPA (%)
1	The company has the necessary risk taking spirit to develop new products.	40.75	54.57
2	Status of NPD in business strategy of the company is clear.	33.25	51.43
3	The company pays attention to the product life cycle in developing new products.	28.25	45.71
4	The company pays attention to planning and infrastructure investment level to develop new products.	36	52.57
5	Company formulates technology task strategies of R&D for new product development projects.	31.25	51.43
6	For new product development, an intelligent system in the company (including innovation management, knowledge management, technology management, strategic WAM) is established.	25	48.29
7	To develop new products, systematic observation of existing and emerging technologies takes place.	29.5	42.00

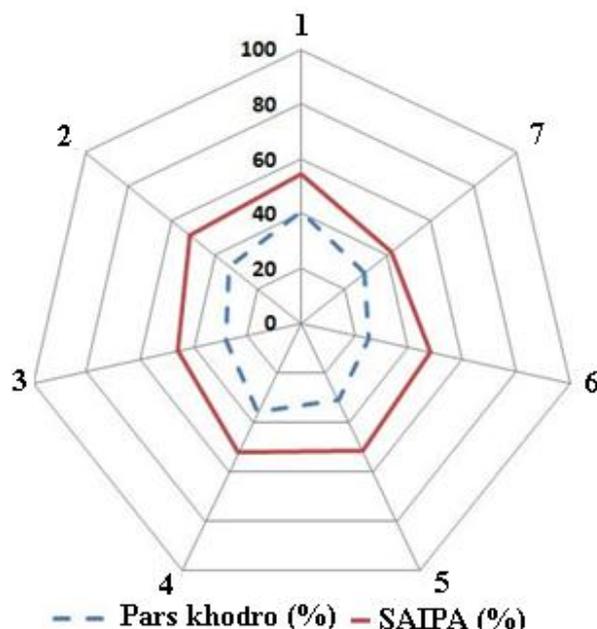


Diagram 7: Comparison of existing level in indexes of strategic aspect in both companies

Q4: Status of indexes in commercialization aspect of new product development management in both companies is given in Table 7 and Diagram 8.

Table 7. Comparison of existing status in indexes in commercialization aspect of product development management

No.	Question/ Index	Pars Khodro (%)	SAIPA (%)
1	Shortening idea to market cycle is considered in new product development by concurrent engineering and timely NPD product delivery to market.	40.5	40.00
2	The company commercializes technologies resulting from new products separately.	25	42.00
3	After sale service design, systematic and timely logistic and support is considered for new product development.	40.75	50.57
No.	Question/ Index	Pars Khodro (%)	SAIPA (%)
4	The company pays attention to problems of the product after useful lifecycle of it in developing new products.	31	43.14
5	Product innovation and attraction in the view of market and customers is considered for development of new products.	34.5	51.14
6	Customer needs and expectations for new product development is systematically identified and considered.	31	45.43

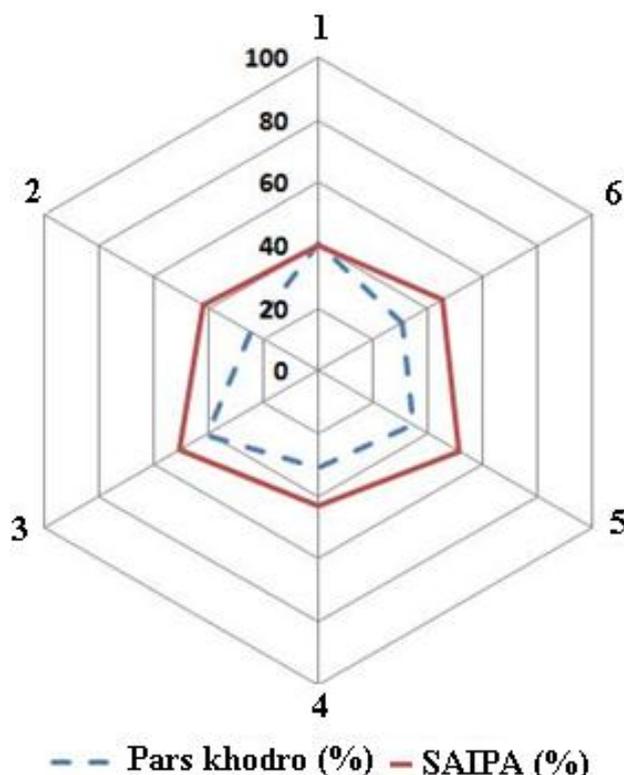


Diagram 8: Comparison of existing level in indexes of commercialization aspect in both companies

RESULTS

As observed in Table 3, Pars Khodro Co. in strategic aspect (32%) and SAIPA Co. in commercialization aspect (45.38%) had poorest performance and they had the best performance in process aspect among key factors of new product development (Pars Khodro = 42.3% and SAIPA = 57.04%). According to results in Diagrams 3 and 4, organizational component has highest rank and process component has lowest rank in new product development in SAIPA Co. these results in Pars Khodro Co. suggests that commercialization and strategic components have highest rank and process component has lowest rank among key factors of new product development. According to results of Table 4, among indexes of process aspect, index of product validation and verification after engineering sample has the best performance in SAIPA and Pars Khodro Co. (65.14 and 59.25 percent, respectively). Index of accurate and correct definition and its configuration in Pars Khodro Co. (30.5%) and index of accurate identification of stakeholder needs (48.29%) are poorest indexes. According to results in Table 5 regarding indexes of organizational aspect, index of top management support and commitment (61.25%) in Pars Khodro Co. and index of sufficient fund provision for NPD management (65.71%) in SAIPA Co. had the best performance. Index of encouraging environment and culture for NPD entrepreneurs in Pars Khodro Co. (33.5%) and SAIPA Co. (47.43%) had lowest score. According to results in Table 6 regarding indexes of strategic aspect, index of risk taking in Pars Khodro Co. (40.75%) and SAIPA Co. (54.57%) had highest score. Index of intelligent system for development in Pars Khodro Co. (25%) and index of systematic observation of existing and emerging technologies in SAIPA Co. (42%) had lowest score in this aspect. According to results in Table 7 regarding indexes of commercialization aspect, index of separate technology commercialization in Pars Khodro Co. (25%) and index of shortening idea to market cycle by concurrent engineering in SAIPA Co. (40%) had lower scores. Index of after sale service design, systematic and timely logistic and support in Pars Khodro Co. (40.75%) and index of product innovation and attraction in the view of market in SAIPA Co. (51.14%) had the best score.

Overall, it can be said there is gap between existing level and optimal level in all aspects of new product development in both companies. Mean gap is deeper in Pars Khodro Co. (62.55%), while the status is better in SAIPA Co. and the gap to optimal level is about 48.26%.

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